(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 890 486 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.01.1999 Bulletin 1999/02

(51) Int Cl.[6]: **B60R 16/02**

(21) Application number: **98202815.1**

(22) Date of filing: **04.08.1997**

(84) Designated Contracting States:
DE GB IE SE

(30) Priority: **05.08.1996 JP 206040/96**
02.09.1996 JP 232174/96
16.12.1996 JP 335658/96

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
97305896.9 / 0 823 352

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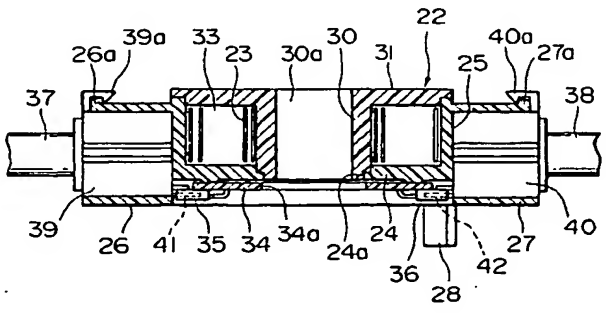
Remarks:
This application was filed on 21 - 08 - 1998 as a divisional application to the application mentioned under INID code 62.

(54) Rotary connector attachment structure

(57) A rotary connector comprising a stationary housing (21) with an outer tubular portion (25), a movable housing (22) coupled to said stationary housing (21) in a relatively rotatable manner and having an inner tubular portion (30) positioned to face said outer tubular portion (25) with an annular storage space (33) defined therebetween, and a flexible cable (23) wound within said storage space and electrically led out to the exterior with both ends of said flexible cable fixed respectively to the outer tubular portion (25) and the inner tubular portion (30),

said stationary housing (21) being provided with receivers (39,40) for detachably holding switch units (37,38), a printed board (34) being fixed to said stationary housing (21) and connectors (35,36) capable of being connected to said switch units (37,38) upon fitting thereof to said receivers being mounted on said printed board.

FIG. 4



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Printed by Jouve, 75001 PARIS (FR)

Description

The present invention relates to an attachment structure for a rotary connector used as connecting means for electrically coupling electrical parts mounted on a steering wheel, e.g., an air bag inflator, to the body side, and a combination switch including various switch units, e.g., a headlight switch and a wiper switch, built therein. The present invention also relates to a steering unit provided with such an attachment structure.

Further, the present invention relates to a rotary connector used as connecting means for electrically coupling electrical parts mounted on a steering wheel, e.g., an air bag inflator and a horn switch, to the body side.

A rotary connector basically comprises a pair of housings coupled to each other in a relatively rotatable manner, and a flexible cable wound within an annular storage space defined between the pair of housings. The flexible cable has both conductor ends fixed to the respective housings and led out of the rotary connector, and connector terminals are attached to the led-out ends of the flexible cable. One of the housings serves as a movable housing and the other housing serves as a stationary housing. When the movable housing is rotated in one direction, i.e., clockwise or counterclockwise, the flexible cable is rolled up or unrolled in the storage space depending on the direction of rotation of the movable housing. The rotary connector having the above-explained construction is incorporated in a steering apparatus of an automotive vehicle and used as connecting means for electrically coupling the column side and the steering wheel side. On this occasion, the stationary housing of the rotary connector is required to be attached to a stator member on the column side.

As a conventional attachment structure for such a rotary connector, there has been employed the so-called steering unit constructed such that a combination switch including various switch units (called stalk switches), e.g., a headlight switch and a wiper switch, built therein is fixed onto the column side beforehand, and the stationary housing of the rotary connector is attached by screws or the like to a flat upper surface of a casing which serves an outer shell of the combination switch. In addition, the movable housing of the rotary connector is locked to the rear side of the steering wheel by using a joint pin or the like. The connector terminals provided at both the ends of the flexible cable are jointed to respective external connectors provided on the combination switch and the steering wheel. With this structure, the movable housing is rotated in either direction, i.e., clockwise or counterclockwise, with turning operation of the steering wheel, while electrical parts mounted on the steering wheel, e.g., an air bag inflator and a horn switch, are always kept electrically connected to the column side through the flexible cable in the rotary connector.

Further, in some cases, both the ends of the flexible cable in the rotary connector are led out from both the housings through wire harnesses, and specific connectors attached to respective ends of the wire harnesses are jointed to corresponding connectors provided on the steering wheel and the combination switch. Additionally, in some cases, wire harnesses having specific connectors attached to their ends are also led out from the stalk switches, and the specific connectors are jointed to corresponding connectors in the combination switch. Then, external connectors provided on the combination switch are jointed to corresponding connectors on the body side.

Meanwhile, the height dimension of a rotary connector greatly depends on the width dimension of a flexible cable used in the rotary connector. For example, when audio switches, etc. are also mounted on a steering wheel in addition to the above-mentioned electrical parts such as the air bag inflator and the horn switch, the number of conductors of the flexible cable must be increased for connection of the increased number of electrical parts. This requires an increase in height dimension of a rotary connector. Also, there has been recently developed an automotive vehicle wherein the angle and direction through and in which a steering wheel is turned are detected by a steering sensor to carry out damping force control of a suspension, shift position control of an automatic transmission, etc. based on a signal detected by the steering sensor. In the trial design of such a recent automotive vehicle, the steering sensor is assembled on a combination switch along with a rotary connector.

However, a space between the combination switch and the steering wheel is restricted. Accordingly, if the above conventional structure of attaching the stationary housing of the rotary connector to the upper surface of the casing of the combination switch is employed, the rotary connector having a large height dimension could not be assembled in the space between the combination switch and the steering wheel. In particular, when the rotary connector and the steering sensor are both to be assembled in that space, the rotary connector is required to have a considerably lessened thickness. In other words, there is a problem that a rotary connector having a large number of conductors to be adaptable for an increased number of circuits cannot be assembled in the space.

Also, the above conventional attachment structure requires many wire harnesses for electrically connecting the rotary connector and the stalk switches to the body side, which results in problems of increasing the total weight of the steering unit and pushing up the production cost. Another problem is that when the stalk switches are repaired or replaced, repairing work is troublesome because the combination switch has to be disassembled after removing both the steering wheel and the rotary connector.

According to a first aspect of the present invention, an opening is formed in a top plate of a casing of a com-

bination switch such that a rotary connector is allowed to enter the opening. By attaching the rotary connector to the casing in a state of being inserted in the opening formed in the top plate of the casing of the combination switch, an effective space between the combination switch and the steering wheel is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in a steering apparatus.

According to a second aspect of the present invention, a rotary connector and stalk switches are jointed by direct coupling to corresponding connectors in a casing of a combination switch, and these connectors are connected to an external connector for collective outputting through one position. With the direct coupling of the rotary connector and the stalk switches to the corresponding connectors in the casing of the combination switch, wire harnesses are no longer required because of the connector-to-connector joint. Therefore, the weight and cost of a steering unit can be reduced. Further, since the steering unit and the body side are electrically interconnected through one position, assembly work is simplified.

According to a third aspect of the present invention, a rotary connector includes receivers provided on a stationary housing thereof and stalk switches constituting switch units are held by the receivers in a detachable manner. By providing the receivers for the stalk switches on the stationary housing itself of the rotary connector, an effective space in the axial direction of the steering shaft is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in the steering apparatus. Also, the stalk switches can be easily repaired or replaced from either side of the rotary connector with no need of removing the steering wheel and the rotary connector.

A rotary connector attachment structure according to the first aspect of the present invention comprises a rotary connector for electrically connecting an electrical part mounted on a steering wheel to the body side, and a combination switch including a plurality of switch units, wherein an opening is formed in a top plate of a casing serving as an outer shell of the combination switch, and the rotary connector is attached to the casing in a state of being inserted in the opening.

The rotary connector comprises a movable housing and a stationary housing coupled to each other in a relatively rotatable manner. The stationary housing can be attached to the casing of the combination switch in any suitable position. But, by fixing attachment lugs provided on the stationary housing to the top plate of the casing around the opening, the top plate of the casing is mechanically reinforced in the vicinity of the opening by the provision of the rotary connector, and therefore the casing of the combination switch can be prevented from lowering its strength.

The switch units are preferably the so-called stalk switches such as a headlight switch and a wiper switch. By detachably attaching the switch units to the sides of the rotary connector, the stalk switches can be easily repaired or replaced with no need of removing the steering wheel and the rotary connector.

A steering unit according to the second aspect of the present invention comprises a rotary connector for electrically connecting an electrical part mounted on a steering wheel to the body side, and a combination switch including stalk switches, wherein a printed board is disposed within a casing serving as an outer shell of the combination switch, connectors capable of being jointed by direct coupling to the rotary connector and the stalk switches are mounted on the printed board, and an external connector connected to those connectors for collective outputting through one position is also mounted on the printed board.

In the above steering unit, by providing movable mechanisms for absorbing offsets in relative positional relationship between the rotary connector and one of the above connectors and between the stalk switches and others of the above connectors, even if there are slight variations in connector mount position when the rotary connector and the stalk switches are jointed by direct coupling to the corresponding connectors, the variations are absorbed by the movable mechanisms. This ensures positive electrical connection between the connectors.

Further, by forming an opening in a top plate of the casing and attached the rotary connector to the casing in a state of being inserted in the opening, an effective space between the combination switch and the steering wheel is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in the steering apparatus.

A rotary connector according to the third aspect of the present invention comprises a stationary housing with an outer tubular portion, a movable housing coupled to the stationary housing in a relatively rotatable manner and having an inner tubular portion positioned to face the outer tubular portion with an annular storage space defined therebetween, and a flexible cable wound within the storage space and electrically led out to the exterior with both ends of the flexible cable fixed respectively to the outer tubular portion and the inner tubular portion, wherein the stationary housing being provided with receivers for detachably holding stalk switches as switch units.

The receivers may be attached as separate members to the stationary housing in a subsequent step, but they are preferably integrally formed with the stationary housing.

In the above rotary connector, by fixing a printed board to the stationary housing and mounting connectors, which are capable of being connected to the stalk switches upon fitting thereof to the receivers, on the

printed board, the stalk switches can be electrically connected to the rotary connector at the same time as when the stalk switches are mechanically coupled to the receivers.

Further, by providing a connector of one-piece united type on a bottom surface of the stationary housing for electrical connection of an outer end of the flexible cable and the stalk switches to an exterior connector on the body side through the connector of one-piece united type, the rotary connector can be electrically connected to the external connector through one point, and hence work of assembling the rotary connector can be simplified.

Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a sectional view showing a steering unit in a state where a rotary connector according to a first embodiment is attached to a combination switch.

Fig. 2 is an exploded perspective view of components shown in Fig. 1.

Fig. 3 is a perspective view of a rotary connector according to a second embodiment, looking from the rear side of the rotary connector.

Fig. 4 is a sectional view showing a state where stalk switches are mounted to the rotary connector shown in Fig. 3.

Fig. 5 is a perspective view of the rotary connector and the stalk switches, shown in Fig. 4, which are disassembled from each other.

Fig. 6 is a perspective view of a connector provided in the steering unit of Fig. 1, and

Fig. 7 is a perspective view of a terminal provided in the connector of Fig. 6.

Preferred embodiments of the present invention will be described with reference to the drawings. Fig. 1 is a sectional view showing a steering unit in a state where a rotary connector according to a first embodiment is attached to a combination switch, and Fig. 2 is an exploded perspective view of components shown in Fig. 1. Fig. 6 is a perspective view of a connector provided in the steering unit, and Fig. 7 is a perspective view of a terminal provided in the connector of Fig. 6.

According to the first embodiment, as shown in those figures, a casing 1 serving as an outer shell of a combination switch comprises a top plate 1a and a pair of side walls 1b which are built up into the form of an inverted-channel being open downward. The casing 1 can be fixed to a column cover or the like (not shown). A circular opening 2 is formed in the top plate 1a and a plurality of insertion guides 3 are vertically provided on the top plate 1a around the opening 2. A guide groove 4 extending horizontally is formed in an inner surface of each of the top plate 1a and the side walls 1b such that a set of three guide grooves 4 is provided in each of left and right end portions of the casing 1. A pair of stalk switches 5, 6 fitted to the left and right end portions of the casing 1 have connectors 5a, 6a and base portions formed with guide ridges 5b, 6b corresponding to the guide grooves 4, respectively. After the guide ridges 5b, 6b are inserted into the casing 1 while engaging in and sliding along the guide grooves 4, the stalk switches 5, 6 are fixed in place by any suitable means, e.g., screw fastening or snap fitting.

A printed board 7 is fixed to the lower open end of the casing 1 by any suitable means, e.g., screw fastening. The printed board 7 has a through hole 8 formed therein for insertion of a steering shaft (not shown). Also, a plurality of connectors 9a, 9b, 9c and circuit parts (not shown) are mounted on the front side of the printed board 7, whereas an external output connector 10 is mounted on the rear side of the printed board 7. The connectors 9a, 9b, 9c are all electrically connected to one external output connector 10 through wiring patterns (not shown) on the printed board. Each of the connectors 9a to 9c includes a movable mechanism described later. The connector 9a is jointed to the connector 5a of the stalk switch 5, the connector 9b is jointed to the connector 6a of the stalk switch 6, and the connector 9c is jointed by direct coupling to a connector of a rotary connector described later.

As shown in Fig. 6, the connector 9a comprises a first moving member 50 for holding a plurality of terminals 19, a second moving member 51 for guiding the first moving member 50 in the X-direction, and a support base 52 for guiding the second moving member 51 in the Y-direction. The first and second moving members 50, 51 and the support base 52 jointly constitute the movable mechanism. As shown in Fig. 7, a bent portion 19a is formed midway each of the terminals 19 so that the terminal 19 has sufficient flexibility. The terminals 19 are projected downward from the underside of the support base 52 and soldered to lands (not shown) on the printed board 7. Though not shown, the other connectors 9b, 9c also include similar movable mechanisms.

On the other hand, an outer shell of the rotary connector is mad up of a stationary housing 11 and a movable housing 12 which are coupled to each other in a relatively rotatable manner. The stationary housing 11 comprises a ring-shaped bottom plate 11a and an outer tubular portion 11b in the cylindrical form with a plurality of attachment lugs 11c provided at an upper end of the outer tubular portion 11b. The movable housing 12 comprises a ring-shaped top plate 12a and an inner tubular portion 12b in the cylindrical form. The inner tubular portion 12b has a center bore 13 formed therethrough for insertion of the steering shaft. An annular storage space is defined by the bottom plate 11a, the outer tubular portion 11b, the top plate 12a and the inner tubular portion 12b of both the housings 11, 12. A flat cable 14 as a flexible cable is wound within the storage space in the form of, e.g., a spiral. The flat cable 14 has a plurality of conductors extending parallel to one another. An outer end of the flat cable 14 is fixed to the outer tubular portion 11b and connected to a stationary side connector 15 of direct coupling type provided on the underside of

the bottom plate IIa. As mentioned above, the stationary side connector 15 is jointed by direct coupling to the connector 9c on the printed board 7. Also, an inner end of the flat cable 14 is fixed to the inner tubular portion 12b and connected to a movable side connector 16 of direct coupling type provided on the top plate 12a.

The rotary connector having the above construction is assembled in a steering apparatus as follows. First, the attachment lugs 11c on the stationary housing 11 are fixed by screws 17 to the casing 1 of the combination switch which is fixed to the column cover or the like. At this time, the stationary housing 11 is inserted through the opening 2 of the top plate Ia, and the attachment lugs 11c are moved down along the corresponding insertion guides 3 until coming into abutment against the top plate 1a. This enables the stationary side connector 15 to be automatically jointed to the connector 9c on the printed board 7, resulting in easier assembly. In a state of the rotary connector being thus attached in place, the rotary connector does not appreciably project above the casing 1 of the combination switch, and an assembly of the rotary connector and the combination switch has a relatively small size in the axial direction of the steering shaft. After that, a steering wheel (not shown) is fixed to the steering shaft. At this time, an engagement hole formed in the rear side of the steering wheel is fitted to a joint pin 18 provided on the movable housing 12, and a connector (not shown) provided on the steering wheel is jointed to the movable side connector 16. As a result, electrical parts mounted on the steering wheel, such as an air bag inflator, are electrically connected to the printed board 7 of the combination switch through the flat cable 14 in the rotary connector, while the printed board 7 is electrically connected through the external output connector 10 to a controller (not shown) provided on the body side.

The stalk switches 5, 6 and the rotary connector are attached to the casing 1 beforehand. A resulting assembly of the stalk switches, the rotary connector and the combination switch constitutes the steering unit. In assembling the steering unit, when the stationary housing 11 of the rotary connector is inserted through the opening 2 of the top plate 1a, and the attachment lugs 11c are guided by the corresponding insertion guides 3 and come into abutment against the top plate 1a, whereupon the stationary side connector 15 is automatically jointed to the connector 9c on the printed board 7. In this state, the attachment lugs 11c of the stationary housing 11 are fixed to the casing 1 by the screws 17. At this time, even if the stationary side connector 15 and the connector 9c are somewhat offset in relative positional relationship, the offsets are absorbed by the movable mechanism provided in the connector 9c, specifically, through movements of the first and second moving members 50, 51 relative to the support base 52 in the X- and Y-directions. Therefore, the stationary side connector 15 and the connector 9c can be surely jointed to each other by direct coupling, while reducing undesired stresses imposed on the joint portion. Further, when the guide ridges 5b, 6b of the talk switches 5, 6 are inserted into the casing 1 while engaging in and sliding along the guide grooves 4, the connectors 5a, 6a of the stalk switches 5, 6 are automatically jointed to the connectors 9a, 9b on the printed board 7, respectively. In this state, the stalk switches 5, 6 are fixed to the casing 1 by any suitable means, e.g., screw fastening or snap fitting. Also in this assembly step, offsets in relative positional relationship between the connectors 5a and 9a and between the connectors 6a and 9b are absorbed by the movable mechanisms provided in the connectors 9a, 9b.

The above steering unit is assembled in a steering apparatus as follows. After fitting the through hole 8 of the printed board 7 and the center hole 13 of the rotary connector on a steering shaft (not shown), the casing 1 is fixed to a stator member such as a column cover by any suitable means, e.g., screw fastening. At this time, the external output connector 10 provided on the rear side of the printed board 7 is jointed by direct coupling to a connector (not shown) provided on the body side. Then, a steering wheel (not shown) is fixed to the steering shaft. At this time, an engagement hole formed in the rear side of the steering wheel is fitted to the joint pin 18 provided on the movable housing 12, and a connector (not shown) provided on the steering wheel is jointed to the movable side connector 16. As a result, electrical parts mounted on the steering wheel, such as an air bag inflator, are electrically connected to the printed board 7 through the rotary connector, while the rotary connector and the stalk switches 5, 6 are electrically connected to the controller on the body side through the external output connector 10 on the printed board 7.

In operation, when the steering wheel is turned clockwise or counterclockwise, resultant rotating force is transmitted to the movable housing 12 through the joint pin 18, whereupon the movable housing 12 is rotated in the same direction as the steering wheel. For example, when the steering wheel is turned counterclockwise from its neutral position, the movable housing 12 is also rotated counterclockwise correspondingly and the flat cable 14 is rolled up around an outer circumferential surface of the inner tubular portion 12b. On the contrary, when the steering wheel is turned clockwise from its neutral position, the movable housing 12 is also rotated clockwise correspondingly and the flat cable 14 is unrolled along an inner circumferential surface of the outer tubular portion 11b. In any state, electrical connection between both the housings 11, 12 is maintained through the flat cable 14.

With the first embodiment described above, since the rotary connector is attached to the combination switch in such a state that most of both the housings 11, 12 of the rotary connector is embedded in the opening 2 formed in the top plate of the casing 1, it is possible to prevent an increase in height dimension of the assembly of the rotary connector and the combination switch (i.e., in dimension of the assembly in the axial

direction of the steering shaft). Therefore, even when the height dimension of the rotary connector is increased to be adaptable for a larger number of circuits, or even when another part such as a steering sensor is integrally provided on the rotary connector, the rotary connector of this embodiment can be assembled in a limited space between the combination switch and the steering wheel.

Further, since the plurality of attachment lugs 11c provided at the upper end of the outer tubular portion 11b of the stationary housing 11 are fixed by the screws 17 to the top plate 1a around the opening 2, the mechanical strength of the upper plate 1a that is inevitably lowered due to the provision of the opening 2 can be reinforced by the attachment of the rotary connector, and therefore the casing 1 of the combination switch can be prevented from lowering its strength.

Additionally, since the stalk switches 5, 6 are detachably attached to the respective sides of the rotary connector, the stalk switches 5, 6 can be repaired or replaced from either side of the combination switch when required, with no need of removing the steering wheel and the rotary connector.

Also, with the above embodiment, because of the direct coupling between the stationary side connector 15 of the rotary connector and the connector 9c on the printed board 7 and between the connectors 5a, 6a of the stalk switches 5, 6 and the connectors 9a, 9b on the printed board 7 in the casing 1 of the combination switch, wire harnesses for electrical connection between the connectors are no longer required and a reduction in both weight and cost of the steering unit can be achieved. Further, since the connectors 9a to 9c are collectively connected to one external output connector 10, the steering unit and the body side are electrically interconnected through one position, resulting in simpler assembly work.

Moreover, because of the connectors 9a to 9c each including the movable mechanism, even if there are slight offsets between parts when the stationary side connector 15 of the rotary connector and the connectors 5a, 6a of the stalk switches 5, 6 are jointed by direct coupling to the corresponding connectors 9a to 9c, the offsets can be absorbed by the movable mechanisms.

While the above first embodiment has been described as using the casing 1 in the form of an inverted-channel being open downward, the shape of the casing 1 may be modified appropriately depending on the design of the combination switch, etc. For example, the printed board 7 may be mounted in the casing 1 comprising a box-shaped casing enclosed at the bottom and being open at left and right sides. Using such a structure is advantageous in increasing the rigidity of the casing 1 and attaching stalk switches which tend to impose larger loads on their base portions.

Also, the above first embodiment has been described as providing the movable mechanisms in the connectors 9a to 9c on the printed board 7. On the contrary, however, the movable mechanisms may be provided in the stationary side connector 15 of the rotary connector and the connectors 5a, 6a of the stalk switches 5, 6. The structure of the movable mechanism is not limited to that illustrated above as the first embodiment.

A second embodiment will be described below with reference to the drawings. Fig. 3 is a perspective view of a rotary connector according to a second embodiment, looking from the rear side of the rotary connector, Fig. 4 is a sectional view showing a state where stalk switches as switch units are mounted to the rotary connector shown in Fig. 3, and Fig. 5 is a perspective view of the rotary connector and the stalk switches, shown in Fig. 4, which are disassembled from each other. As shown in these drawings, the rotary connector of this embodiment basically comprises a stationary housing 21, a movable housing 22 rotatably coupled to the stationary housing 21, and a flexible cable 23 stored in both the housings 21, 22.

In the second embodiment, the stationary housing 21 comprises a bottom plate 24 having a center hole 24a formed therein, an outer tubular portion 25 vertically extending from an outer circumferential edge of the bottom plate 24, and a pair of holder walls 26, 27 projecting laterally to the left and right from the outer tubular portion 25. These components are integrally formed of resin by simultaneous molding. The holder walls 26, 27 serve as receivers for holding stalk switches described later, and are each in the form of a box being open at a side end opposite to the outer tubular portion 25. Also, the holder walls 26, 27 have latch projections 26a, 27a provided on respective upper surfaces thereof, and guide grooves 26b, 27b extending horizontally and formed in respective inner surfaces thereof. Further, a stationary side connector 28 of one-piece united type is attached to a lower end of the outer tubular portion 25, and a plurality of attachment lugs 29 are formed at every joint corners between the lower end of the outer tubular portion 25 and bottom surfaces of the holder walls 26, 27.

On the other hand, the movable housing 22 comprises an inner tubular portion 30 having an insertion bore 30a formed therethrough, and a ring-shaped top plate 31 extending radially outward from an upper end of the inner tubular portion 30. These components are also integrally formed of resin by simultaneous molding. A movable side connector 32 is provided on the top plate 31. The stationary housing 21 and the movable housing 22 are coupled to each other in a relatively rotatable manner through snap action or the like. An annular storage space 33 is defined by the bottom plate 24, the outer tubular portion 25, the inner tubular portion 30 and the top plate 31 of both the housings 21, 22. The flexible cable 23 is wound within the storage space 33 in the form of, e.g., a spiral. The flexible cable 23 is called a flat cable and has a plurality of conductors, though not shown, supported on a belt-like base film. An outer end of the flexible cable 23 is fixed to the outer tubular portion 25 and its conductors are connected to respective

terminals of the stationary side connector 28. Also, an inner end of the flexible cable 23 is fixed to the inner tubular portion 30 and its conductors are connected to respective terminals of the movable side connector 32.

A printed board 34 is fixedly screwed to the bottom plate 24 of the stationary housing 21, and has a through hole 34a formed therein. A pair of connectors 35, 36 and other circuit parts are mounted on the rear side of the printed board 34 and wired to the remaining terminals of the stationary side connector 28. The connectors 35, 36 are located to face the interiors of the holder walls 26, 27, respectively.

Stalk switches 37, 38 are lever-like switch units with a headlight switch and a wiper switch built therein, and have respective base portions 39, 40 each in the form of a rectangular pillar. The base portions 39, 40 have lock claws 39a, 40a formed on their upper surfaces, and guide ridges 39b, 40b formed on their both side surfaces, respectively. In addition, connector pins 41, 42 are projected on respective front surfaces of the base portions 39, 40. One stalk switch 37 is detachably attached to the holder wall 26 on the left side. More specifically, when the guide ridges 39b of the stalk switch 37 are inserted into the holder wall 26 while engaging in and sliding along the guide grooves 26b, the lock claw 39a is snapped in place after riding over the latch projection 26a, whereby the base portion 39 is fixed in the holder wall 26. On this occasion, the connector pins 41 are jointed to the connector 35 of the printed board 34 and the stalk switch 37 is electrically connected to the stationary side connector 28 through the connector 35. Likewise, the other stalk switch 38 is detachably attached to the holder wall 27 on the right side. More specifically, when the guide ridges 40b of the other stalk switch 38 are inserted into the holder wall 27 while engaging in and sliding along the guide grooves 27b, the lock claw 40a is snapped in place after riding over the latch projection 27a, whereby the base portion 40 is fixed in the holder wall 27. On this occasion, the connector pins 42 are jointed to the connector 36 of the printed board 34 and the stalk switch 38 is electrically connected to the stationary side connector 28 through the connector 36.

The rotary connector of the second embodiment having the above construction is assembled in a steering apparatus as follows. First, the through holes 34a of the printed board 34 and the insertion bore 30a of the movable housing 22 are fitted over the steering shaft (not shown) and the attachment lugs 29 on the stationary housing 21 are fixedly screwed to an attachment member, e.g., the column cover. At this time, if an external connector (not shown) of direct coupling type is provided on the attachment member, the stationary side connector 28 can be jointed to the external connector at the same time as when the stationary housing 21 is fixedly attached in place. As an alternative, an external connector with lead wires may be employed for implementing work of attaching the stationary housing 21 and work of jointing it to the external connector separately from each other. After that, the steering wheel (not shown) is fixed to the steering shaft. At this time, the rear side of the steering wheel is locked to the top plate 31 of the movable housing 22 with a joint pin or the like, and an external connector (not shown) provided on the steering wheel is jointed to the movable side connector 32. As a result, electrical parts mounted on the steering wheel, such as an air bag inflator, are electrically connected to a controller (not shown) provided on the body side through the movable side connector 32, the flexible cable 23 and the stationary side connector 28.

Then, the stalk switches 37, 38 are inserted into the corresponding holder walls 26, 27, respectively, such that the stalk switches 37, 38 are mechanically coupled to the holder walls 26, 27 and their connector pins 41, 42 are electrically connected to the connectors 35, 36. As a result, the stalk switches 37, 38 are electrically connected to the controller (not shown) provided on the body side through the connectors 35, 36 and the stationary side connector 28. Note that while the stalk switches 37, 38 have been described above as being fitted to the holder walls 26, 27 after the rotary connector is assembled in the steering apparatus, but the work of fitting the stalk switches may be carried out before the rotary connector is assembled in the steering apparatus.

In operation, when the steering wheel is turned clockwise or counterclockwise, resultant rotating force is transmitted to the movable housing 22, whereupon the movable housing 22 is rotated in the same direction as the steering wheel. For example, when the steering wheel is turned counterclockwise from its neutral position, the movable housing 22 is also rotated counterclockwise correspondingly and the flexible cable 23 is rolled up around an outer circumferential surface of the inner tubular portion 30. On the contrary, when the steering wheel is turned clockwise from its neutral position, the movable housing 22 is also rotated clockwise correspondingly and the flexible cable 23 is unrolled along an inner circumferential surface of the outer tubular portion 25. In any state, electrical connection between the steering wheel and the body side is maintained through the flexible cable 23, and electrical connection between the stalk switches 37, 38 and the body side is also maintained.

With the second embodiment described above, since the holder walls 26, 27 serving as receivers for holding the stalk switches 37, 38 are provided on the stationary housing 21 of the rotary connector and arranged to extend substantially radially outward of the storage space 33 storing the flexible cable 23, it is possible to prevent an increase in total height dimension of the rotary connector including a combination of both the stationary housing 21 and the stalk switches 37, 38 (i.e., in dimension of the rotary connector in the axial direction of the steering shaft). Therefore, even when the height dimension of the rotary connector is increased to be adaptable for a larger number of circuits, or even

when another part such as a steering sensor is integrally provided on the rotary connector, the rotary connector can be assembled in a limited space below the steering wheel.

Further, since the stalk switches 37, 38 are detachably attached to the holder walls 26, 27, the stalk switches 37, 38 can be easily repaired or replaced from either side of the rotary connector when required, with no need of removing the steering wheel and the rotary connector.

Since the printed board 34 is fixed to the stationary housing 21 and the connectors 35, 36 capable of being connected to the stalk switches 37, 38 upon fitting thereof to the holder walls 26, 27 are mounted on the printed board 34, the stalk switches 37, 38 can be electrically connected to the rotary connector at the same time as when the stalk switches 37, 38 are mechanically coupled to the holder walls 26, 27.

Additionally, since the stationary side connector 28 of one-piece united type is provided on the bottom surface of the stationary housing 21 and the outer end of the flexible cable 23 and the connectors 35, 36 on the printed board 34 are wired to the stationary side connector 28, the rotary connector can be electrically connected to the external connector on the body side through one point, i.e., the stationary side connector 28, even though the stalk switches 37, 38 are fitted to the rotary connector. It is thus possible to simplify work of assembling the rotary connector.

While the above second embodiment has been described as providing the stationary side connector 28 of one-piece united type on the bottom surface of the stationary housing 21, a stationary side connector for jointing the outer end of the flexible cable 23 to the external connector and a stationary side connector for jointing the stalk switches 37, 38 to the external connector may be provided separately from each other.

The first aspect of the present invention can be practiced in the form of the first embodiment described above and can provide advantages below.

With the structure that an opening is formed in the top plate of the casing of the combination switch and the rotary connector is attached to the casing in a state of being inserted in the opening, an effective space between the combination switch and the steering wheel is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in the steering apparatus.

Further, with the structure that the attachment lugs provided on the stationary housing of the rotary connector are fixed to the top plate of the casing around the opening, the top plate of the casing is mechanically reinforced in the vicinity of the opening by the provision of the rotary connector, and therefore the casing of the combination switch can be prevented from lowering from its strength.

Additionally, with the structure that the switch units are detachably attached to the sides of the rotary connector, the switch units can be easily repaired or replaced with no need of removing the steering wheel and the rotary connector.

The second aspect of the present invention can be practiced in the form of the first embodiment described above and can provide advantages below.

With the structure that between the rotary connector and the stalk switches are jointed by direct coupling to the corresponding connectors in the casing of the combination switch and these connectors are collectively connected to one external connector for outputting through one position, wire harnesses for electrical connection between the connectors are no longer required and a reduction in both weight and cost of the steering unit can be achieved. Further, the steering unit and the body side are electrically interconnected through one position, resulting in simpler assembly work.

Also, with the structure of including the movable mechanisms for absorbing offsets in relative positional relationship between the rotary connector and the corresponding connector and between the stalk switches and the corresponding connectors, even if there are slight variations in connector mount position when the rotary connector and the stalk switches are jointed by direct coupling to the corresponding connectors, the variations are absorbed by the movable mechanisms. This ensures positive electrical connection between the connectors.

Further, with the structure that the opening is formed in the top plate of the casing and the rotary connector is attached to the casing in a state of being inserted in the opening, an effective space between the combination switch and the steering wheel is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in the steering apparatus.

The third aspect of the present invention can be practiced in the form of the second embodiment described above and can provide advantages below.

The rotary connector has a structure comprising the stationary housing with the outer tubular portion, the movable housing coupled to the stationary housing in a relatively rotatable manner and having the inner tubular portion positioned to face the outer tubular portion with an annular storage space defined therebetween, and the flexible cable wound within the storage space and electrically led out to the exterior with both ends of the flexible cable fixed respectively to the outer tubular portion and the inner tubular portion. The stationary housing is provided with the receivers extending substantially radially outward of the storage space, and the receivers hold stalk switches in a detachable manner. With this structure, an effective space in the axial direction of the steering shaft is essentially so enlarged that a rotary connector having a relatively large height dimension can be assembled alone or even along with another part, such as a steering sensor, in the steering apparatus. Al-

so, the stalk switches can be easily repaired or replaced from either side of the rotary connector with no need of removing the steering wheel and the rotary connector.

Further, with the structure that the printed board is fixed to the stationary housing and the connectors capable of being connected to the stalk switches upon fitting thereof to the receivers are mounted on the printed board, the stalk switches can be electrically connected to the rotary connector at the same time as when the stalk switches are mechanically coupled to the receivers.

Additionally, with the structure that a connector of one-piece united type is provided on the bottom surface of the stationary housing for electrical connection of the outer end of the flexible cable and the stalk switches to the exterior connector on the body side through the connector of one-piece united type, the rotary connector can be electrically connected to the external connector through one point, and hence work of assembling the rotary connector can be simplified.

Claims

1. A rotary connector comprising a stationary housing with an outer tubular portion, a movable housing coupled to said stationary housing in a relatively rotatable manner and having an inner tubular portion positioned to face said outer tubular portion with an annular storage space defined therebetween, and a flexible cable wound within said storage space and electrically led out to the exterior with both ends of said flexible cable fixed respectively to the outer tubular portion and the inner tubular portion, characterised in that:

   said stationary housing is provided with receivers for detachably holding switch units; a printed board is fixed to said stationary housing and connectors capable of being connected to said switch units upon fitting thereof to said receivers are mounted on said printed board.

2. A rotary connector as claimed in Claim 1, characterised in that a connector of one-piece united type is provided on a bottom surface of said stationary housing for electrically connecting an outer end of said flexible cable and said switch units to an exterior connector on the body side through said connector of one-piece united type.

FIG. 1

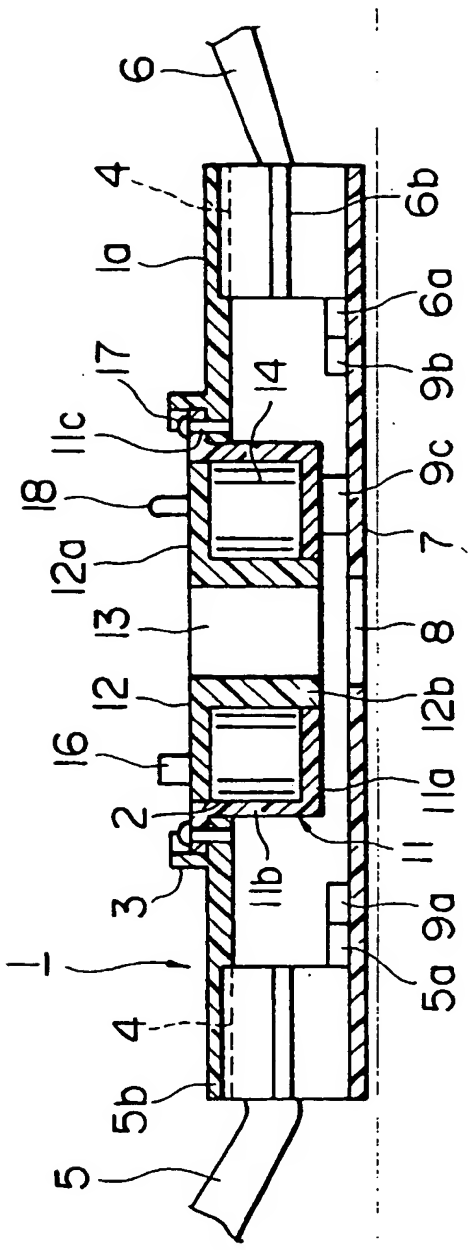


FIG. 2

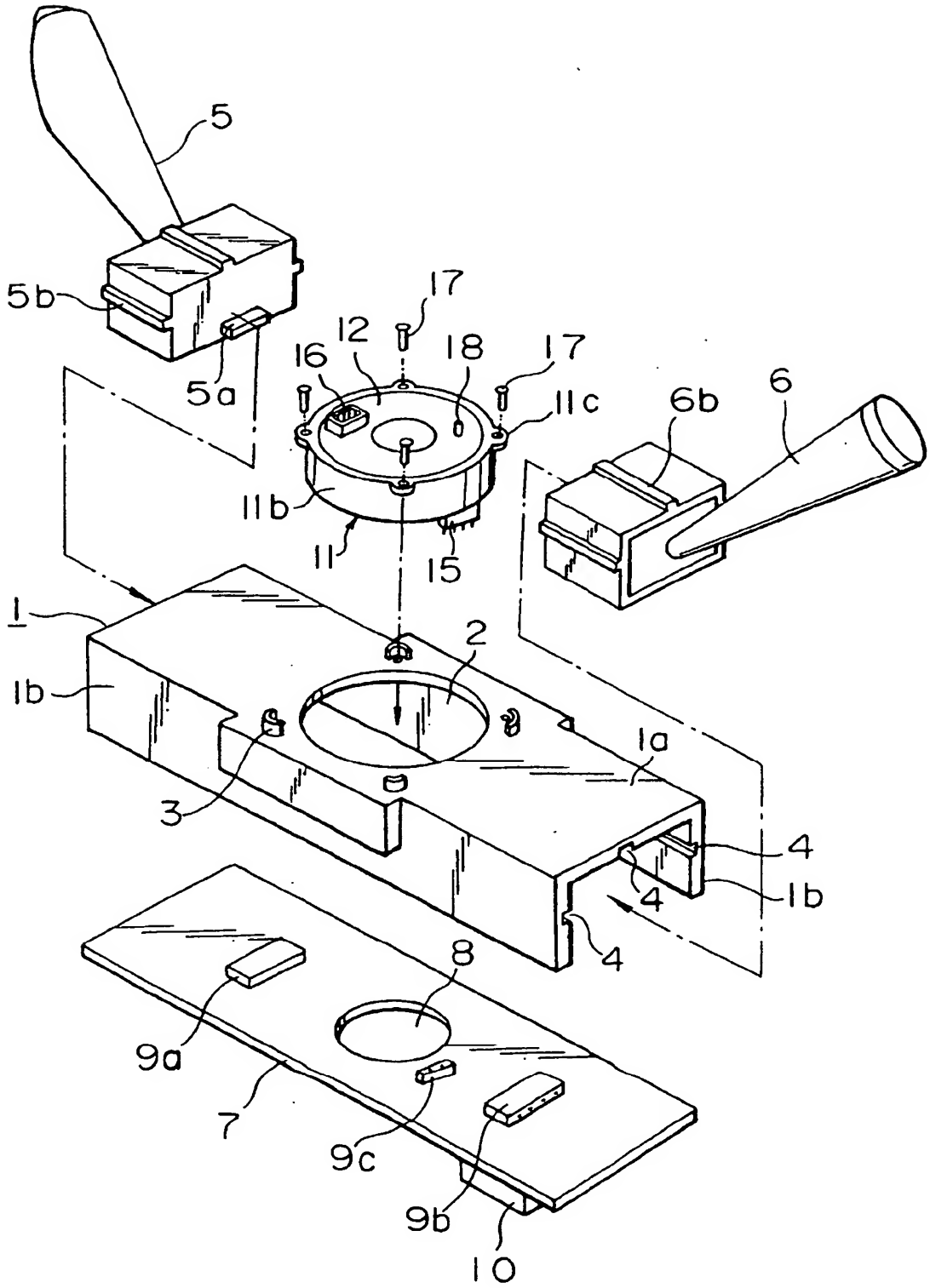


FIG. 3

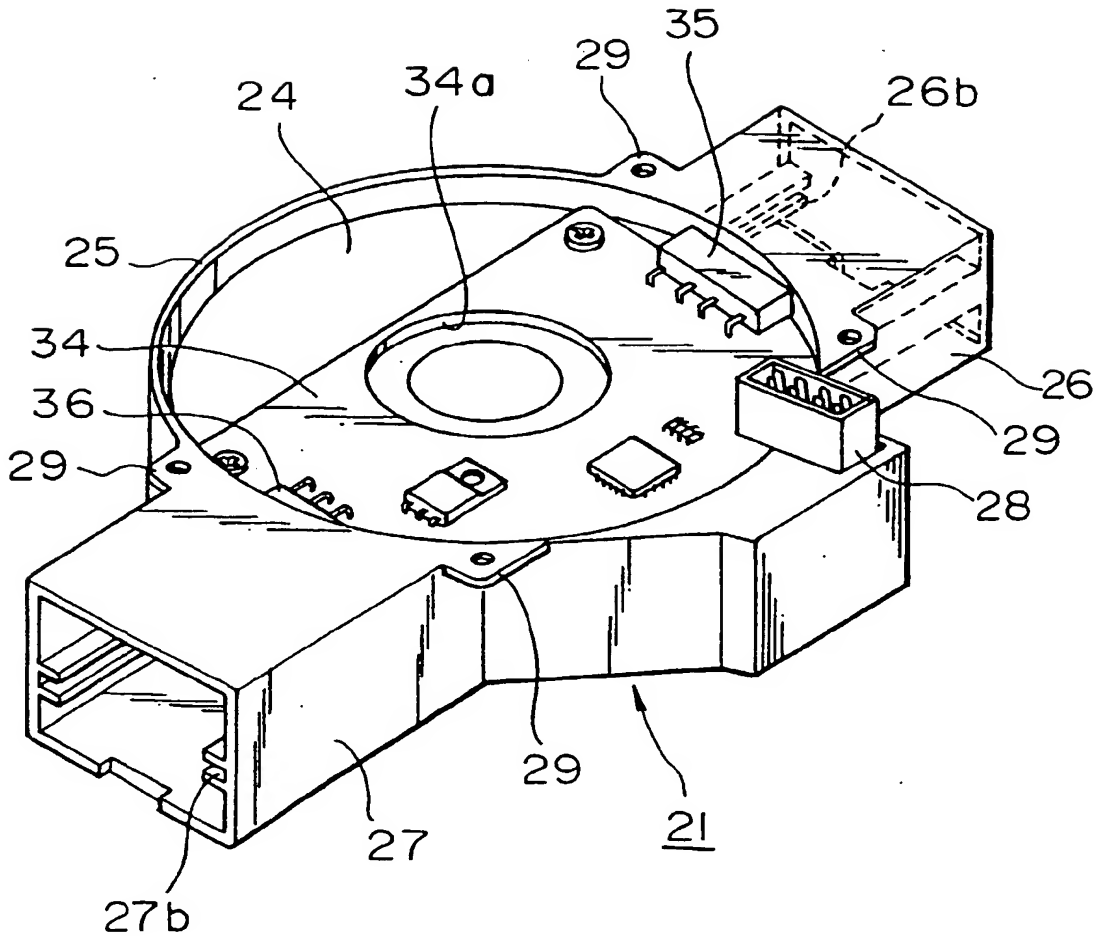


FIG. 4

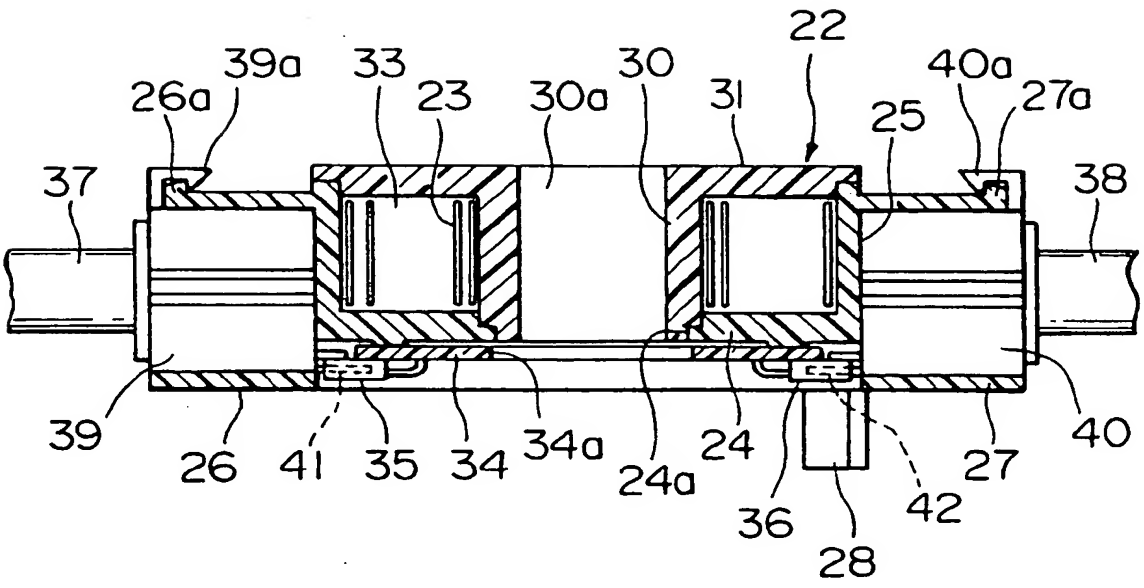


FIG. 5

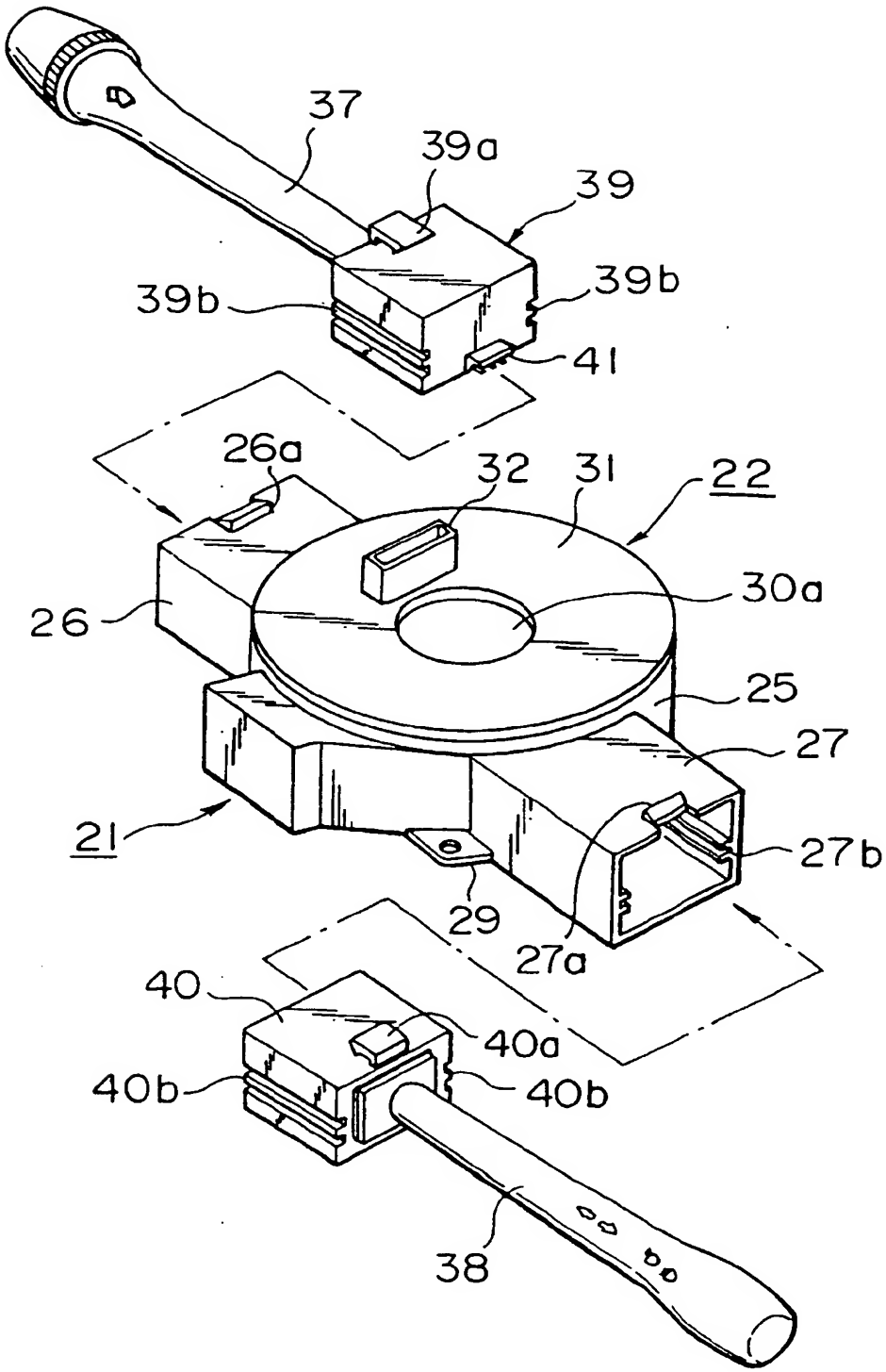


FIG. 6

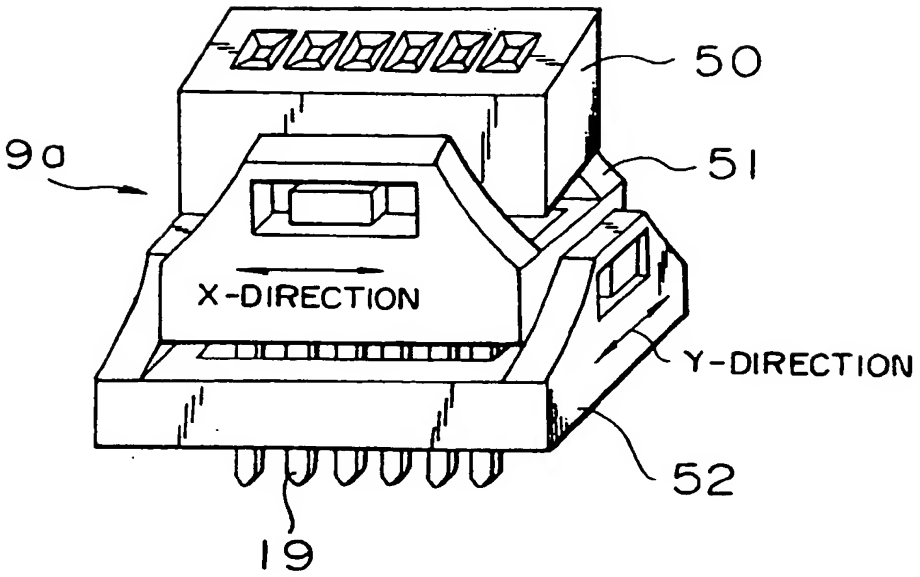
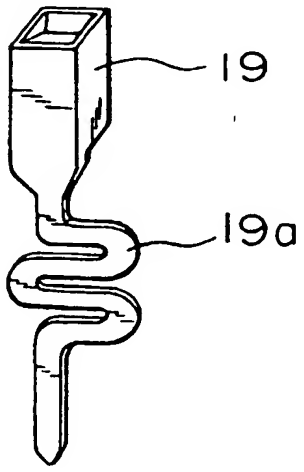


FIG. 7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 98 20 2815

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
A	FR 2 568 421 A (FRANZ KIRSTEN ELEKTROTECHNISCHE SPEZIALFABRIK) 31 January 1986 * page 5, line 25 - page 6, line 20; figures 1,3,4 *	1	B60R16/02
A	DE 195 11 693 A (ITT AUTOMOTIVE EUROPE GMBH) 30 November 1995 * column 5, line 5 - column 6, line 31; figures 1,5,6 *	1	
A	WO 95 09744 A (VALEO ÉLECTRONIQUE) 13 April 1995 * page 5, line 3 - line 30; figure 1 *	1	
P,A	EP 0 771 693 A (NILES PARTS CO., LTD) 7 May 1997 * column 2, line 47 - line 57 * * column 3, line 9 - line 12; figures 1-3 *	8	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6)
			B60R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	20 October 1998	Deprun, M

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